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THE NATION'S R & D EFFORT

HANDOUT

Research, Development, Test, and Evaluation Department

School of Acquisition Management

UNITED STATES ARMY LOGISTICS MANAGEMENT CENTER

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DEPARTMENT OF THE ARMY
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SECTION I

AN OVERVIEW

Throughout United States history, we find that science and technology have been incorporated into the Federal government, primarily in support of specific goals of public policy. As technical needs arose that could not be satisfied by the private sector, the Federal government was obliged to step in.

During the early years of the nation, Federal interest in scientific and technical fields was confined to such areas enumerated in the Constitution as patents, the census, coinage, weights and measures, and mapping.

As time passed, attention was drawn to agriculture, natural resources, foods and drugs, mining, transportation, communications, and the social sciences.

World War II accelerated participation of the scientific community in many fields. The continuing need for a strong research capability was recognized in the post-war period and steps were taken to provide for the support of basic research, science education, peaceful uses of nuclear power, and attacks on the diseases of man.

The past decade has been characterized by a competition for attention among three major fields: research to widen the horizons of science, research with military goals, and research to cope with emerging social and environmental problems.

No one will argue with the premises that science and technology are vital national resources or that science and technology have revolutionized society. Witness, for example, the fantastic lessening of time and distance. Nations can now be destroyed within hours. Yet, the same cooperation and competition that normally envelop human activity also enwrap science and technology. Many people seek to promote accord in these matters. At the same time, conflicts of interest have fostered competition. Today, one such conflict centers around the location of Federal scientific installations, and the geographical and institutional allocation of Federal contracts. This struggle, of course, is one manifestation of the bidding for limited resources.

In military matters, science and technology have altered the way that men fight, but not the need for leaders and managers. Nor have they obviated the need for the capability to conduct limited wars without weapons of mass destruction. To the contrary, the need is all the greater if civilization is to survive a test of strength between major powers. In short, we should not become so mesmerized by scientific and technological change that we fail to recognize and appreciate the lasting phenomena of society.

Certainly science and technology have changed our environment and consequently our problems. One could acknowledge that they have made life more complex But there is a vast difference in human problems between their complexity and their gravity.

It has been said that the Federal government's primary objective in R&D is to develop national scientific and technological capabilities as far as possible as a prelude to continued social and economic progress. In the long run, science and technology are dependent on two factors:

a. The maintenance and augmentation of scientific knowledge through research.

b. Improved scientific education and advancement in competence of young scientists and engineers.

A major reason for Army involvement in research is to assure that all technological areas important to the Army are exploited. The Army must be the leader and perform the bulk of the research in certain areas if the work is to be done. It is necessary for the Army to do research in other areas in order to fill gaps and study fundamental problems having direct bearing on the Army's mission.

The details and concepts of the nation's scientific efforts are constantly multiplying. The most characteristic feature of these activities, the one that clearly predominates, is the law of change. Knowledge advances at such a rate that men and institutions must adjust their perspectives to meet newly discovered needs and opportunities. On the one hand, technology is the servant of our social purposes and must respond to new demands and changing priorities based on considerations of economic growth or public health or military strategy. On the other hand, science itself attempts "new understanding through exploration and analysis, so that what was not known yesterday becomes a working hypothesis today and an everyday product tomorrow."[1]

SECTION II

ORGANIZATION FOR R&D

In reviewing the history of Federal science organization, a few generalizations appear valid.

a. The predominant organizational response by the Federal government to emerging needs has been to give already existing agencies added responsibilities for new functions. In cases where the new function has been of such scope as to make this impracticable, a new entity has been formed. The consequence is the present diffused science organization within the Federal government.

b. Scientific endeavor as an end in itself has only recently been supported by tax revenues.

c. The issue of increased centralization of Federal science management has been raised periodically by the Congress.

THE LEGISLATIVE BRANCH

The Congress

In the House of Representatives, the Committee on Science and Astronautics, and especially its Subcommittee on Science, Research, and Development, is very active. It has issued reports since 1965 on R&D and national goals; the applications of science and technology; the organization, administration, and Federal funds for science and technology; and science and technology in foreign affairs. The Committee on Government Operations is also interested in R&D affairs.

In the Senate, the Committee on Aeronautical and Space Sciences, the Committee on Government Operations, and the Select Committee on Small Business are all interested in R&D matters. There is also a Joint Committee on Atomic Energy.

The 90th Congress (1967-68) passed 94 public laws authorizing, funding, or otherwise affecting R&D in the United States. Congress also took legislative action on 45 other bills relating to these matters. In all, 32 congressional committees held 327 hearings on various aspects of public policy for science and technology. The Congress received 212 related statements from the President. Our legislative branch appropriated $33.7 billion for research, development, and related activities during its two-year term.

The Library of Congress operates the National Referral Center for Science and Technology, established in 1962, which serves as a clearinghouse for the scientific and technical community. It does not answer questions directly, but refers interested individuals to the proper organizations, institutions, or individuals.

General Accounting Office

The GAO was created in 1921 and vested with powers that dated back in some cases, as far as 1789. Its purpose is to "assist the Congress in providing legislative control over the receipt, disbursement, and application of public funds...."[2] If GAO's FY 70 budget request is approved by the Congress, approximately 425 staff members (about one-third of the staff) will be involved in defense R&D, procurement, and supply management. A separate group has been established in the GAO to put more emphasis on problems associated with acquisition of major weapons systems.

THE EXECUTIVE BRANCH

The President of the United States

Article II, section 1, of the Constitution provides that "the executive power shall be vested in a President of the United States of America..." The President is the administrative head of the executive branch of the Government, which includes numerous agencies as well as the executive departments.

The Cabinet is a creation of custom and tradition, going back to the first President, and functions at the pleasure of the President. Its purpose is to advise the President on any matter concerning which he wishes such advice.

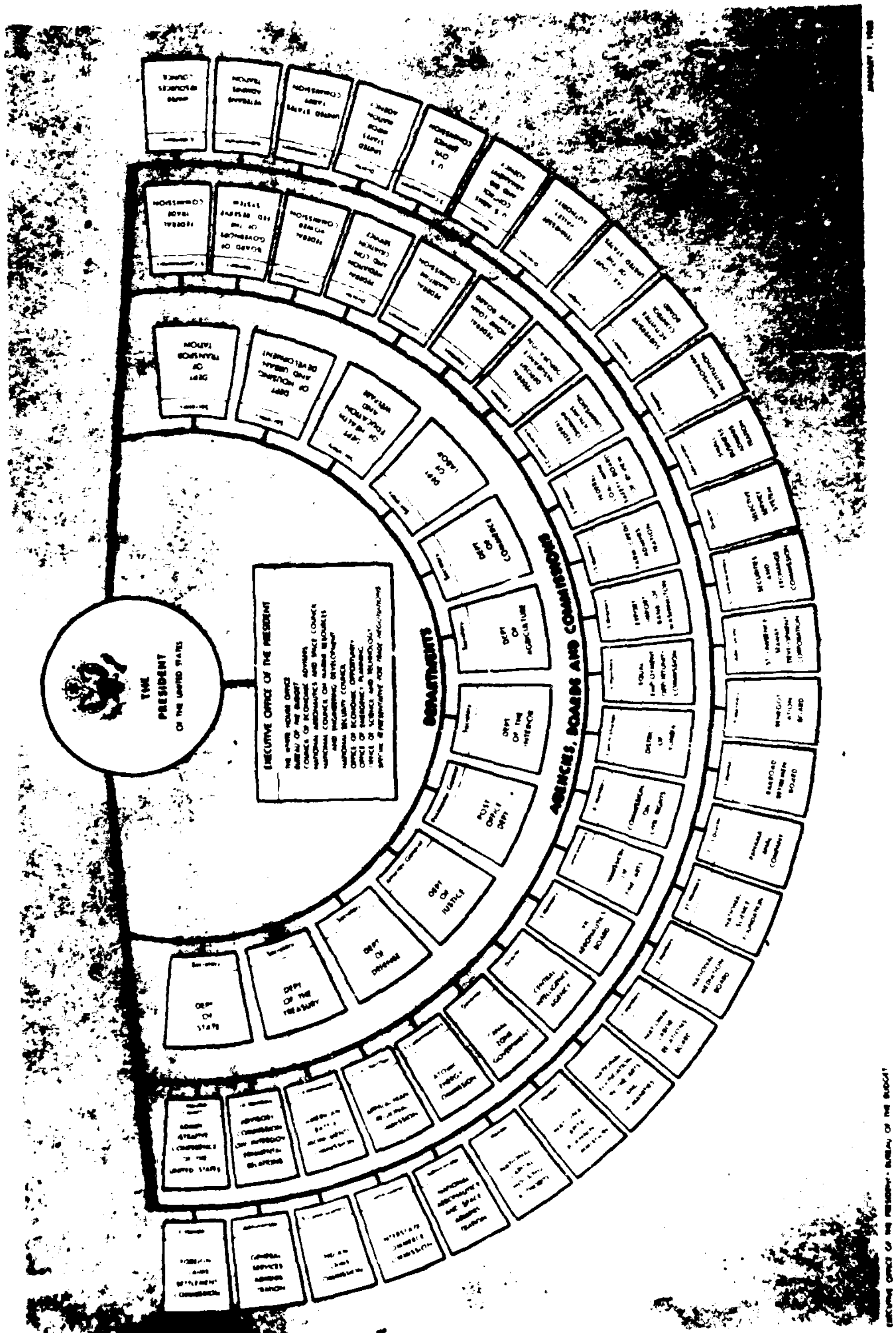
Executive Office of the President

Four of the ten agencies that constitute this office are concerned with R&D:

a. Bureau of the Budget.

Established in 1921, the BOB has a Director of Economics, Science, and Technology Programs, who has the responsibility to review and develop recommendations concerning agency programs and budget requests.

EXECUTIVE BRANCH OF THE GOVERNMENT



b. National Aeronautics and Space Council.

Established in 1958, the Council consists of the Vice President of the United States as Chairman, and the Secretaries of State and Defense, the Administrator of the NASA, and the Chairman of the Atomic Energy Commission as members. The functions are to advise and assist the President regarding policies, plans, and programs; to fix the responsibilities of the U. S. agencies engaged in aeronautical and space activities; and to develop a comprehensive program of such activities. The Council has a staff of about 30 individuals.

c. National Council on Marine Resources and Engineering Development.

The Council was established in 1966 to provide advice and assistance to the President with regard to his responsibilities to develop and maintain a coordinated, comprehensive, and long-range national program to assure that marine science and technology are most effectively used in the interests of national security and the general welfare. The chairman is the Vice President of the U. S. The members are the Secretaries of State, Navy, Interior, Commerce, Health, Education and Welfare, and Transportation; the Chairman of the Atomic Energy Commission; and the Director of the National Science Foundation. The staff numbers about 50 professional and administrative personnel.

d. Office of Science and Technology.

Established in 1962, the Office provides advice and assistance to the President with respect to developing policies and coordinating programs to assure that science and technology are used most effectively in the interests of national security and general welfare. The Office's staff amounts to about 80 people.

Executive Departments

Nine of the twelve executive departments are concerned with R&D:

a. Department of State.

The Director of International Scientific and Technological Affairs, with rank equivalent to an assistant secretary, advises the Department and the Foreign Service on science and technology as it relates to foreign policy in international relations and directs the overseas Scientific Attache Program.

b. Department of Defense.

The Director of Defense Research and Engineering (DDRE) is the principal adviser and staff assistant to the Secretary of Defense in the functional fields of scientific and technical matters; basic and applied research; research, development, test, and evaluation of weapons, weapons systems, and defense materiel; and design and engineering for suitability, producibility, reliability, maintainability, and materials conservation. He supervises all research and engineering activities in the Department of Defense.

The Advanced Research Projects Agency (ARPA) is a separately organized, civilian staffed, research and development agency of the DOD under the direction and supervision of the DDRE. It was created in 1958 in response to an urgent need for centralized management of selected research projects, especially those not definitely identified with a particular weapons system, military mission, or military service. Its staff numbers approximately 75 people. Generally, its goal is to determine the feasibility of a technique or system. Then the project is transferred to one of the military services.

The Weapons Systems Evaluation Group (WSEG) provides the DOD with analyses and evaluations under projected conditions of war. The Group functions under the administrative direction of the DDRE and is mainly staffed with military officers.

There is also a small Defense Science Board, within the office of the DDRE, that provides advice to the DDRE and the Secretary of Defense.

The Assistant to the Secretary of Defense (Atomic Energy) is the principal staff assistant on atomic energy matters.

The Joint Chiefs of Staff are the principal military advisers to the President, the National Security Council, and the Secretary of Defense. In the realm of R&D, they provide statements of military requirements and strategic guidance for use in developing programs for scientific research and development.

The Defense Documentation Center, operated by the Defense Supply Agency, provides the central facility for reports of Defense-sponsored R&D efforts.

A recent edition to the Defense Department's research activity is a program called Project THEMIS. This has the goal of increasing the number of educational institutions that are capable of performing research relevant to defense missions. To date, 92 programs at 66 universities in 40 states are involved, with the Army monitoring 29 of the programs.[3]

Army research now includes over 3,000 tasks in the life, physical, environmental, social, and other allied sciences. The tasks are performed by 60 Army laboratories, approximately 225 universities and colleges, 161 non-profit institutions, and over 300 private firms.[4]

The Army also utilizes the specialized capabilities of two Federal Contract Research Centers: Research Analysis Corporation and the Human Resources Research Office.

c. Post Office Department.

One of the Assistant Postmasters'General is in charge of the Bureau of Research and Engineering. He is responsible for the development of new concepts, systems, and techniques for processing, movement, and delivery of mail; development, design, and testing of postal equipment and materials; architectural and engineering services for the planning and construction of all new or enlarged postal facilities; and design of mechanical and electrical utilities and building equipment.

d. Department of the Interior.

Research efforts are conducted in several elements of the department, with policy direction, coordination, control, and administration exercised by the Science Advisor to the Secretary. Areas of concern are the minerals and solid-fuels industries, the petroleum and gas industries, conversion of saline water, the coal industry, the electric-power industry, water supply, the fisheries industry, the sportfish and wildlife resources, geological surveying, land management, outdoor recreation, and reclamation of arid and semiarid lands.

e. Department of Agriculture.

Research efforts are in the areas of agricultural and industrial chemistry, the industrial uses of farm products, entomology, soils, agricultural engineering, agricultural economics, marketing, crop and livestock production, production and manufacture of dairy products, human nutrition, home economics, forestry, and conservation. The Director of Science and Education has staff supervision over these efforts.

f. Department of Commerce.

The Assistant Secretary for Science and Technology oversees research activities to improve and extend scientific, engineering, and commercial standards; to advance knowledge of the oceans, earth, and the atmosphere; and to better understand the functioning of the national economy. Commerce also administers the Nation's patent and trademark systems. Among the Department's operating units are the Bureau of the Census, Maritime Administration, Environmental Science Services Administration, and National Bureau of Standards. The last named operates the Clearinghouse for Scientific and Technical Information.

g. Department of Health, Education, and Welfare.

The Assistant Secretary (Health and Scientific Affairs) assists and advises the Secretary in the development of policies and legislation and in the coordination of the Department programs and activities in health, medical affairs, and the life sciences generally; population dynamics; scientific affairs; science communications; and consumer protection. The Food and Drug Administration and the National Institutes of Health function under the Surgeon General who reports to this office. The Assistant Secretary (Individual and Family Services) is responsible for research in aging, mental retardation, rural development, urban assistance, regional economic development, and community planning. The Social Security Administration and the Office of Education are separate operating units of the Department.

h. Department of Housing and Urban Development.

The Director of Urban Technology and Research is the principal advisor to the Secretary on research, technological, and demonstration matters.

i. Department of Transportation.

The Assistant Secretary for Research and Technology is responsible for scientific and technologic research and development relating to the speed, safety, and economy of transportation; abatement of noise generated by transportation equipment; and transportation of hazardous materials. The Department's operating units include the U. S. Coast Guard, the Federal Aviation Administration, the Federal Highway Administration, and the Federal Railroad Administration.

Independent Agencies

Four independent agencies in the Executive Branch of the Federal government are directly concerned with R&D:

a. Atomic Energy Commission.

Established in 1946, the AEC has an Assistant General Manager for Research and Development and several R&D facilities to carry out the provisions of the Atomic Energy Act, the purpose of which is to provide by national policy that the development, use, and control of atomic energy shall be directed to make the maximum contribution to the general welfare and to the common defense and security, and to promote world peace, increase the standard of living, and strengthen free competition in private enterprise.

b. National Aeronautics and Space Administration.

NASA was established in 1958 to conduct research for the solution of problems of flight; develop, construct, test, and operate aeronautical and space vehicles; conduct activities required for the exploration of space with manned and unmanned vehicles; and arrange for the most effective utilization of the scientific and engineering resources of the United States with other nations engaged in aeronautical and space activities for peaceful purposes. The entire NASA organization is oriented to R&D, but there is an Assistant Administrator for Technology Utilization.

c. National Science Foundation.

NSF was established in 1950 to strengthen basic research and education in the sciences in the United States. It does this by developing information on scientific resources, awarding grants and contracts in support of basic research, awarding graduate fellowships, sponsoring programs aimed at improving scientific education, and fostering the interchange of scientific information. The Foundation has a staff of about 1,500 persons.

d. Smithsonian Institution.

Created in 1846, it is legally an establishment having as its members the President of the U. S., the Vice President, the Chief Justice, and the members of the Cabinet. The Institution is a private, nonprofit corporation, but it administers a number of Government programs placed under its control by the Congress and funded by Federal appropriations. Among these are the Science Information Exchange, which serves the entire scientific community with information about research in progress, and the International Exchange Service, which is the official U. S. agency for international exchange of official U. S. scientific and literary publications.

Selected Boards, Committees, and Commissions

a. Federal Council for Science and Technology.

The Council was formed in 1959 to promote closer cooperation among Federal agencies, to facilitate resolution of common problems, to improve planning and management in science and technology, and to advise and assist the President regarding Federal programs affecting more than one agency.

b. President's Science Advisory Committee.

This Committee was established in 1951 to advise the President in matters relating to science and technology. The Committee Secretariat is provided by the Office of Science and Technology.

QUASI-OFFICIAL AGENCIES

National Academy of Sciences

The Academy was established by an act of Congress in 1863. It is an organization of distinguished scientists and engineers dedicated to the furtherance of science and its use for the general welfare. Although not a governmental agency, the Academy has long enjoyed close relations with the Federal Government. Its congressional charter of 1863 specifies that the Academy shall, whenever called upon by any department of the Government, investigate, examine, experiment, and report upon any subject of science or art. It has about 800 members.

National Academy of Engineering

This Academy was established in 1964 when the Council of the National Academy of Sciences, under the authority of its Act of Incorporation, adopted articles of organization to bring the Academy into being as a parallel organization, autonomous in its organization and election of members, and closely coordinated with the Academy of Sciences in its advisory activities. It has about 200 members.

National Research Council

The NRC was organized by the National Academy of Sciences in 1919 to facilitate the participation of a broader representation of scientists and technologists. The NRC now serves the National Academy of Engineering in a similar capacity and has become, in effect, the principal operating agency for both Academies. It has about 300 members.

The NRC program is carried out by bringing together the most competent scientists and engineers in the country to deal broadly with scientific and engineering problems and to exchange information in the furtherance of research. Work is carried out through permanent boards as well as ad hoc groups, and a staff of about 700 people is maintained. The Research Council does not maintain laboratories. The effectiveness of the Research Council is dependent on the personal participation of thousands of American scientists and engineers who collaborate in these undertakings, giving generously of their time and effort without financial compensation. The organization directly administers several million dollars annually of funds provided by contributions, grants, and contracts from Federal and State agencies, private industries, foundations, and individuals.

SELECTED MULTILATERAL INTERNATIONAL ORGANIZATIONS

United Nations and Specialized Agencies

a. Food and Agriculture Organization.

b. United Nations Educational, Scientific, and Cultural Organization.

c. World Health Organization.

d. World Meteorological Organization.

Inter-American Organizations

a. Inter-American Institute of Agricultural Sciences.

b. Pan American Health Organization.

Other International Organizations

a. International Atomic Energy Agency.

b. International Council of Scientific Unions and 15 Associated Unions.

c. International Hydrographic Bureau.

SECTION III

ECONOMIC IMPACT OF R&D

We have stated that science and technology are national resources, both in themselves and as tools for improving other resources. Science and technology increase the value of material resources by amplifying their usefulness. No doubt our most important resource, the one that utilizes all others, is man. While the material sectors of our society have experienced tremendous advances, the human being remains the initiator, innovator, and user.

Economists agree that a positive correlation exists between progress in science and technology and economic growth; they differ, however, on how far this correlation extends.

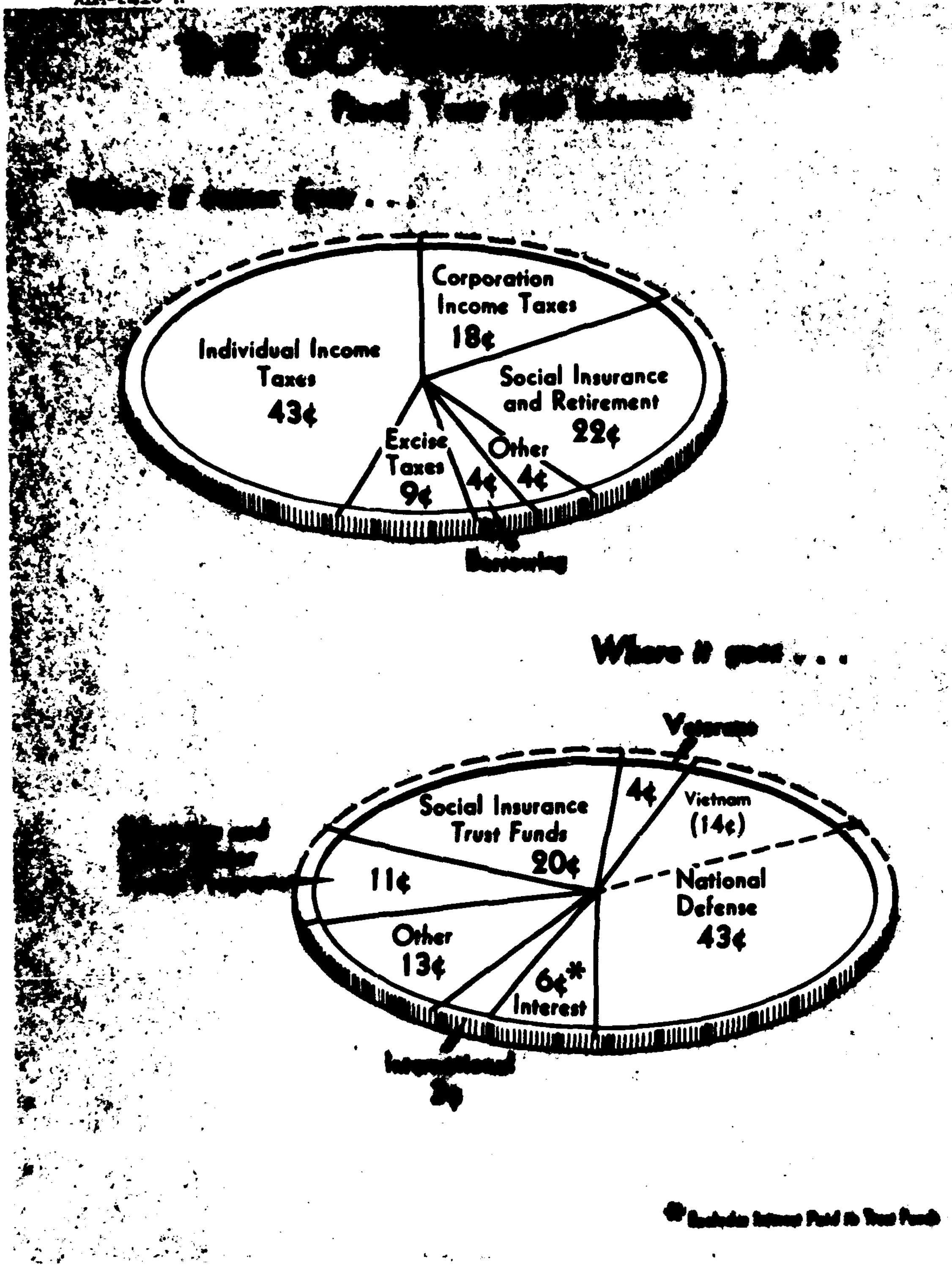
The great discovery of our age is that technological innovation need not be haphazard. In fact, "the discovery of systematized innovation may turn out to be a qualitative change in the economy--one having the same importance for future growth as the development of the concept of capital investment itself had during the past two centuries."[5]

Science and technology can be viewed both as intellectual activities and as national resources.

FINANCIAL ASPECTS OF R&D

R&D in the United States has been growing at a rapid pace since 1940. World War II launched R&D as a large-scale national activity. Investment in R&D gathered momentum during the 1950's, and showed a compound rate of growth of 17 percent for the decade. By the mid-1960's the United States was pouring some $14 billion a year into R&D. Because of price-level increases, however, the percentage increase in real terms is less than that reflected in the dollar figures. While it is difficult to correlate R&D expenditures with economic growth, R&D expenditures represent an increasing share of the Gross National Product, rising from 1.4 percent in the early 1950's to some 3 percent in the mid-1960's.[6]

Defense expenditures are a large percentage--about 43%--of the Federal administrative budget. What does this money go for? About 26% of all defense expenditures is for procurement of major items, 18% is for R&D, 3% is for construction, and 53% is for operating expenses.[7]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Individual Income Taxes 43¢
Social Insurance and Retirement 22¢
Excise Taxes 9¢
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Other 4¢
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Vietnam (14¢)
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National Defense 43¢
Other 13¢
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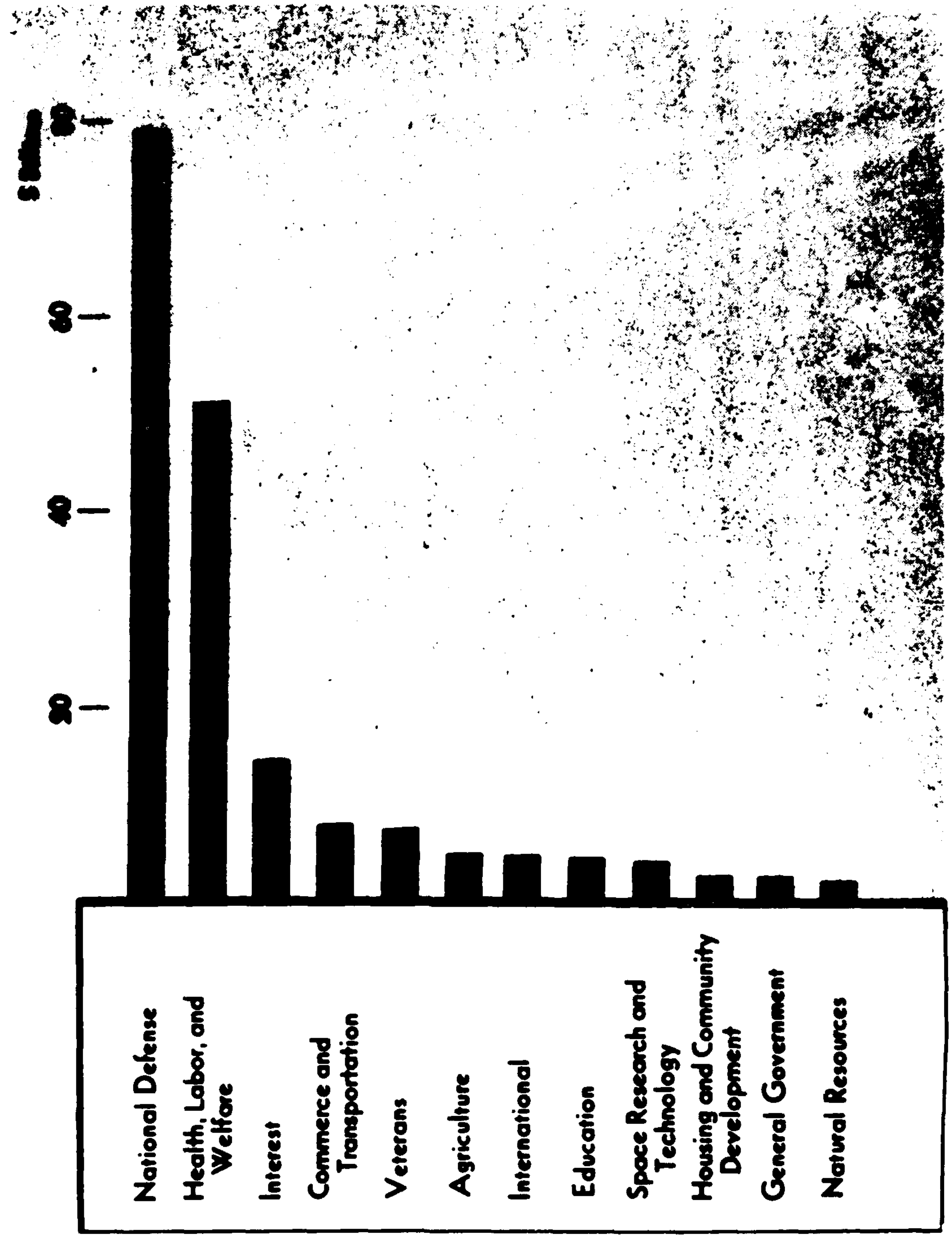

1969 Outlays by Function

National Defense

Fiscal year	Total outlays (in millions)	Percent of total budget outlays
1969 estimate........	$79,789	42.9%
1968 estimate........	76,489	43.5
1967................	70,092	44.2
1966................	56,770	42.2
1965................	49,583	42.0
1964................	53,651	45.2
1963................	52,211	46.9
1962................	51,179	47.8
1961................	47,491	48.5

What are the effects of these large expenditures on the economy? According to some observers, it is only the stimulus of defense spending that has kept the U. S. economy from returning to the mass unemployment of the 1930's. According to another view, defense has not been an economic burden because the resources devoted to it would have been wasted on trivia and status symbols.

The largest source of R&D funds is the Federal government, accounting for some 66 percent. Industry finances almost one-third of the total R&D in the country, and colleges and non-profit institutions support the remaining two to three percent. The aircraft and missiles industry and the electrical equipment and communications industry together use almost 60 percent of the total industrial R&D funds.

These industries, along with the scientific and mechanical measuring-instruments industry, were the only ones that financed over one-half of their R&D with Federal government funds. Federal R&D funds have generally gone to relatively few companies. Industry-supported R&D is somewhat more widely distributed among companies than is government-supported R&D.

The development side of R&D receives double the support accorded research. The reasons for this are easy to find. First, development offers more immediate rewards and men tend to rationalize resource use in utilitarian terms. Second, it is more expensive to fashion hardware than to discover facts of nature.

The growth of Federal support for R&D has been remarkable. During the period from 1940 to the mid-1960's, R&D expenditures reached the phenomenal growth rate of some 22 percent per year, in current price-level terms. As a percent of total Federal expenditures, R&D expanded from 0.8 percent to about 15 percent.[8]

Six Federal agencies receive the lion's share of R&D monies--the Department of Defense, the National Aeronautics and Space Administration, the Atomic Energy Commission, the Department of Health, Education, and Welfare, the Department of Agriculture, and the National Science Foundation. While the DOD share remains high, it has dropped from 80 percent of the total Federal R&D funding in 1955 to about 45 percent. NASA funding has grown at the rate of about 57 percent a year, compared to less than 10 percent for DOD.[9]

The FY 69 Army RDTE program consisted of:

a.	Research	$94.3 million
b.	Exploratory Development	238.4 million

c.	Advanced Development	371.7 million
d.	Engineering Development	151.6 million
e.	Management and Support	266.3 million
f.	Operational Systems Development	543.5 million
	Total	$1,665.8 billion[10]

The major areas of State research are agriculture, health, education, and public works, all of primary concern to State governments.

To offer some contrasts in Federal efforts--or perhaps more accurately, our national goals--the total of all Federal defense spending, as a percent of the Federal budget, declined from 49% in 1959 to 41% in 1969, while Federal welfare spending rose from under 30% to nearly 40%. In dollar terms, military spending has remained relatively stable around $80 billion, but non-defense costs have gone from $92 billion to $110 billion. The total cost of social-welfare purposes (Federal, state, and local) total well over $100 billion. The Vietnam war added $27 billion to the Federal budget.[11] Programs for population control and family planning cost only $116 million.[12]

MANPOWER CONSIDERATIONS

Today the U. S. population is over 200 million. Just one century ago, it was 30 million. By 2000, there may be 300 million of us. We are the richest, most powerful, best educated, and best fed, housed, and clothed nation in the annals of man.

In round numbers, of the 200 million today, about 102 million are females, 106 million are 25 years old and over, our average age is 27.7. About 85 million have been born since 1945, 19 million are under five years of age and 19 million are over 65 years of age, 120 million are old enough to vote, 33 million are white-collar workers, while 27 million are blue-collar workers.

From 1966 to 1975, those in the age bracket 20-24 will increase 37%, those in the age bracket 25-29 will increase 50%, and those in the age bracket 30-34 will increase 27%.

About the turn of the century, one farm worker could supply food for seven people. Today, one farm worker can feed almost 40 people.

From 1966 to 1975, more doctor's and master's degrees will be granted than were granted in the preceding 50 years. College enrollment will jump 40% by 1975.[13]

From 1947 to 1968, the U. S. population increased by 39%. During the same period, Federal employment rose 38%, but state and local employment jumped 130%.

Out of every ten persons employed by some arm of government (non-military personnel) 1 was employed in the Federal government, 3 were in public education, and 5 were in State and local governments.

One vital ingredient of a national capability in R&D is manpower--chiefly scientists and engineers. Manpower, rather than money or materials, is often the pacing item.

The population of the U. S. has increased at an average rate of about one and one-half percent since 1940, compared to five percent for manpower in science and technology.

The total number of people engaged in science and technology in 1940 accounted for 1.5% of the civilian labor force. In 1963, it was up to 3.6% and by 1970 it is expected to reach 4.7%.

Approximately 40 percent of today's scientists are primarily engaged in R&D activities, while about 30 percent of the engineers are in R&D.[14]

Taking the trends of the past decade as a basis, the Department of Labor has projected the requirements for scientists and engineers in 1975. The number available could fail to meet the requirement for engineers by 15%, and barely equal the demand for scientists.

Dr. James Killian, while President Eisenhower's science advisor, pegged the half-life of an engineer's usefulness at about 7 1/2 years. He suggested two forms of engineering obsolescence: a failure to take new academic courses that the older engineer did not have in his earlier education, and a discontinued need for the knowledge he has. In a survey of five engineering schools and five engineering specialisations during a five-year period of time, it was found that there were 192 course additions and 182 deletions out of a beginning total of 870 courses.[15]

TECHNOLOGY TRANSFER

There is another aspect of the economic impact of defense programs that may be more illusive and controversial, but possibly of greater significance in the long run. This is the "spin-off" or transfer of defense technology to other areas of the economy. There is no simple method of measuring the dollar impacts, but from the point of view of benefits to the private sector, four main effects have been identified:

a. The emergency of new technologies, such as electronics, is stimulating investment in new industries.

b. These new technologies induce existing industries to replace or improve old facilities, equipment, and processes.

c. These new facilities, equipment, and processes call forth new investment to finance cost-saving innovations and increased output. Examples are computerized record keeping and production control.

d. New technologies often permit new locations for industries.[16]

New space-age sealants, developed for caulking seams in space craft, now plug the gaps in bathroom tiles. Latex paints, developed as a protection against ultraviolet radiation, are being applied to home walls. The need for manageable space foods has given impetus to the improvement of freeze-dried foods for the civilian kitchen.

By adapting the compact electronic equipment designed to monitor the life functions of space travelers, doctors are able to watch a ward full of patients. Space satellites are relaying radio and TV signals across thousands of miles of ocean and gathering a wealth of weather information.

Of more prosaic and short-range nature, the Apollo program at its peak in 1966 employed 400,000 people, from Long Island to Seattle.[17]

The systems approach to management of multiple skills employed in the space program, is being adapted to civilian use in tackling more earthly problems in urban planning, pollution, and mass transportation.

SECTION IV

A FORECAST

No matter how important the influence of science and technology upon society has been in the past, it is likely to prove but a pale shadow of the influence we may expect in the future.

Dr. Glenn T. Seaborg, Chairman, Atomic Energy Commission, in speaking at the University of California on 12 June 1965, said "The scientific revolution is here to stay...indeed, it is only beginning. What we have seen in the past is as nothing compared to the future. We shall be found wanting if we do not plan with that thought in mind. Our success in achieving the objectives of creative evolution require both an ever more vigorous effort in science and technology and an enormous improvement in techniques for integrating the products of science and technology into society."[18]

The subcommittee on Science, Research, and Development of the Committee on Science and Astronautics, U. S. House of Representatives, has isolated certain areas that appear to require comprehensive attention at the national level in the near future:

a. Technological assessment. A capability for this is needed now in a new, different, and insistent way as compared to former times. Technological change produces numerous and diverse effects--some recognizable before the fact, others not until later; some good and others bad; some never clearly established in a cause-and-effect relationship.

b. Environmental quality. In 1965, the U. S., through the National Academy of Sciences, elected to participate in the largest ecology-based research program in the history of science. The 50-nation program is known as the International Biological Program. Its objectives are a worldwide study of organic production on the land, in fresh water, and in the seas, so that adequate estimates may be made of the potential yield of new as well as existing natural resources; and a worldwide study of human adaptability to the changing conditions of environment.

c. Utilization of Federal laboratories. The subcommittee is considering the role and responsibility of existing Federal laboratories in further applying science and technology to present-day requirements for law enforcement and crime control. The subcommittee also is concerned about the lack of interest in interagency use of Federal laboratories.

d. Institutional grants for science. Testimony by representatives of educational associations and individual universities indicated agreement that (1) the quality and quantity of needed higher education in the U. S. will suffer if financial assistance is not provided, and (2) some form of Federal assistance to institutions of higher learning beyond that currently received is essential.

e. Urban problems. The subcommittee recognizes a need to investigate methods by which new science and technology can be more rapidly and efficiently applied to the problems of the American city.[19]

Dr. John S. Foster, Jr., Director of Defense Research and Engineering, is concerned over an impending slippage in U. S. technological superiority over the Soviet Union. The Soviets have pulled roughly even with the U. S. in the amount of effort put into defense-related R&D. Furthermore, the Soviet Union is increasing its efforts at a disturbing rate--by about 10% a year during the past few years. During the same period, U. S. defense R&D spending has gone up about four percent a year. However, the annual rate of inflation in the costs of doing R&D is estimated between 5 and 8 percent. If this continues, the U. S., for the first time in its history, will lose its technological superiority.

The Russians have a Gross National Product that is about half of ours, but their investment in strategic weapons is more than ours.

Secretary of Defense Laird recently announced that R&D programs should be spared from further administration budget cuts. He is concerned about the equipment that the troops will be using in the 1974-75 and later time periods. He recognizes that the Pentagon has been forced to delay many programs because of the Vietnam conflict.

Dr. Foster has characterized the R&D program in the jargon of the investment business: "We must maintain a basic portfolio of growth securities, devote a small fraction of our resources to high-risk but promising speculative ventures, and maintain a capital reserve of technical competence adequate to cope with unexpected technological threats or opportunities as they arise."[20]

Mr. Laird said he "does not expect a deep or prolonged cut in the absolute dollar amount spent for military purposes, even after Vietnam." It is premature to predict the level of defense spending that the Administration will recommend for future years. Secretary Laird then added, "The Administration is going about the problem of fixing its priorities and translating them into budgetary terms by the most orderly method ever used in Washington. In this process, the claims of all agencies, including defense, are weighed against each other and against available resources."[21]

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13. ABSTRACT

A summary of the research and development in the U. S. in terms of abrief history, some discussion of the federal organizations involved, some financial and manpower considerations, mention of the transfer of defense technology to the civilian sector, and a forecast of subjects for attention.

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Defense R&D	8					
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Resources	10					
Funds	10					
Manpower	10					
Organization	10					
Economics	10					